Introduction

1. INTRODUCTION

The use of plants as a source of medicine has been inherited and is an important component of the healthcare system in India. In the Indian system of medicine, most practitioners formulate and dispense their recipes. The validation of such recipes requires proper documentation and research. In the Western world also, the use of herbal medicines is steadily growing with approximately forty per cent of the population reporting the use of herbs to treat medical illness within the past few years (Bent and Ko, 2004).

Free radicals and related species have attracted a great deal of attention in recent years. They are mainly derived from oxygen / reactive oxygen species (ROS) and nitrogen (reactive nitrogen species / RNS) and are generated in our body by various endogenous systems, exposure to different physiochemical conditions or pathophysiological states (Devasagayam *et al.*, 2004).

The ROS and RNS include diverse reactive entities namely superoxide ($O_2^{\bullet -}$), hydroxyl ($OH^{\bullet}$), peroxyl ($ROO^{\bullet}$), peroxinitrite ($^{\bullet}ONOO^{-}$) and nitric oxide ($NO^{\bullet}$) radicals, as well as non-free radical species such as hydrogen peroxide (H_2O_2), nitrous acid (HNO_2) and hypochlorous acid (HOCl) (Mavi *et al.*, 2003).

Free radicals react with organic substrates such as lipids, proteins and DNA. Lipids are highly prone to free radical damage, resulting in lipid peroxidation that can lead to adverse alterations. Free radical damage to proteins can result in the loss of enzyme activity. Damage caused to DNA can result in mutagenesis and carcinogenesis. Through oxidation, free

radicals cause damage to these molecules disturbing their normal function, and may, therefore, contribute to a number of diseases including inflammation, cancer, atherosclerosis, diabetes, liver injury, Alzheimer's disease, Parkinson's disease and coronary heart pathologies (Duan *et al.*, 2006).

On the other hand, the aerobic organisms have developed antioxidant defense mechanisms that arrest the damage caused by ROS and RNS entities. The defense mechanism can be enzymic or non-enzymic. In the enzymic mechanisms are included, for instance, superoxide dismutase, catalase, glutathione reductase and peroxidase, nitric oxide synthase enzymes. On the contrary, in the non-enzymic mechanisms, are comprised antioxidants and trapping agents such as ascorbic acid, α-tocopherol, β-carotene, glutathione, flavonoids, uric acid, vitamin K, cysteine, serum albumin, bilirubin and trace elements like zinc and selenium (Chae *et al.*, 2004).

Since the natural antioxidant mechanism can be inefficient under some circumstances, a dietary intake of antioxidant compounds becomes an alternative. Therefore, there is an increasing interest in searching for antioxidants from natural origin to scavenge free radicals to prevent the human body from oxidative stress produced by ROS and RNS (Gonclaves *et al.*, 2005).

An animal model is a non-human animal that has a disease or injury that is similar to a human condition. The use of animal models allows researchers to investigate disease states in ways which would be inaccessible in a human patient, performing procedures on the non-human animal that

imply a level of harm that would not be considered ethical to inflict on a human (http://en.wikipedia.org/wiki/Animal_model).

In 1959, William Russel and Rex Burch published "The Principles of Human Experimental Technique", in which they proposed that if animals were to be used in experiments, every effort should be made to replace them with non-sentient alternatives, to reduce to a minimum, the number of animals used, and to refine experiments which used animals so that they caused the minimum pain and distress. These guiding principles, the "3 Rs" of animal research, were initially given little attention. Gradually, however, they have become established as essential considerations when animals are used in research. The three principles of Replacement, Reduction and Refinement have also proven to be an area of common ground for research workers who use animals and who oppose their use (Flecknell, 2002).

The most popular invertebrate model organisms, *Drosophila melanogaster* and *Caenorhabditis elegans*, have been used extensively in many areas of biological research, especially genetics and development. The use of these models is supported by the existence of highly conserved molecular pathways between invertebrates and humans. Combined with the powerful genetics, cellular and molecular biology tools available, these model systems are very suitable for drug discovery research (Tickoo and Russell, 2000).

Drosophila melanogaster is a popular experimental animal because it is easily cultured in mass out of the wild, has a short generation time, and mutant animals are readily obtainable (Ashburner *et al.*, 2005)

Triticum aestivum, commonly called as wheat grass, is an important medicinal plant, which can be consumed by both animals and humans. The proponents of wheat grass claim regular ingestion of the plant can improve the digestion, prevent cancer, diabetes and heart diseases and detoxify heavy metals from the blood stream (Murphy, 2002). In an earlier study conducted in our laboratory, the 4^{th} day grass proved to possess better antioxidant activity than the 8^{th} day and 12^{th} day (Vidya, 2007). Therefore, in the present study, the 4-day old wheat grass was selected as the candidate plant.

The objectives of the study were

1. To analyse the effect of oxidative stress on *Drosophila melanogaster*
2. To study the effect of the administration of *Triticum aestivum* leaf extract on the antioxidant status of *Drosophila melanogaster*
3. To study the combined effect of oxidative stress and *Triticum aestivum* extract on the antioxidant status of *Drosophila melanogaster*.

In the next chapter, a detailed review of literature that supports this study is presented.